**CONTROL ID:** 1809921**TITLE:** Olivine Weathering and Sulfate Formation Under Cryogenic Conditions**AUTHORS (FIRST NAME, LAST NAME):** Paul B Niles[1], Dadi C Golden[3], Joseph R Michalski[2, 4]**INSTITUTIONS (ALL):** 1. ARES, Johnson Space Center, Houston, TX, United States.
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**ABSTRACT BODY:** High resolution photography and spectroscopy of the martian surface (MOC, HiRISE) from orbit has revolutionized our view of Mars with one of the most important discoveries being wide-spread layered sedimentary deposits associated with sulfate minerals across the low to mid latitude regions of Mars. The mechanism for sulfate formation on Mars has been frequently attributed to playa-like evaporative environments under prolonged warm conditions. An alternate view of the ancient martian climate contends that prolonged warm temperatures were never present and that the atmosphere and climate has been similar to modern conditions throughout most of its history. This view has had a difficult time explaining the sedimentary history of Mars and in particular the presence of sulfate minerals which seemingly need more water.

We suggest here that mixtures of atmospheric aerosols, ice, and dust have the potential for creating small films of cryo-concentrated acidic solutions that may represent an important unexamined environment for understanding weathering processes on Mars. This study seeks to test whether sulfate formation may be possible at temperatures well below 0°C in water limited environments removing the need for prolonged warm periods to form sulfates on early Mars.

To test this idea we performed laboratory experiments to simulate weathering of mafic minerals under Mars-like conditions. The weathering rates measured in this study suggest that fine grained olivine on Mars would weather into sulfate minerals in short time periods if they are exposed to H2SO4 aerosols at temperatures at or above -40°C. In this system, the strength of the acidic solution is maximized through eutectic freezing in an environment where the silicate minerals are extremely fine grained and have high surface areas. This provides an ideal environment despite the very low temperatures.

On Mars the presence of large deposits of mixed ice and dust is undisputed. The presence of substantial sulfur-rich volcanism, and sulfur-rich surface deposits also makes it very likely that sul-fate aerosols have also been an important component of the martian atmosphere. Thus mixtures of ice, dust, and sulfate aerosols are likely to have been common on the martian surface. Given the fact that it is not difficult to achieve surface temperatures above -40°C on Mars throughout its history, it seems likely that sulfate formation on Mars is controlled by the availability of sulfate aerosols and not by the martian climate.

The current polar regions of Mars and Earth provide interesting analogs. Large regions of sulfate-rich material have been detected on and around the modern north polar region of Mars. The prevalence of ice-dust mixtures in this region and the existence of sulfates within the ice cap itself are strong evidence for the origin of the sulfates from inside the ice deposits. In addition sulfates have been found in ice deposits in Greenland and Mount Fuji on Earth that have been attributed to forming within the ice deposit. These sulfates can form either through interaction with dust particles in the atmosphere or through weathering inside the ice itself.

**KEYWORDS:** 5415 PLANETARY SCIENCES: SOLID SURFACE PLANETS Erosion and weathering, 0790 CRYOSPHERE Weathering, 1039 GEOCHEMISTRY Alteration and weathering processes, 6225 PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS Mars.(No Image Selected)(No Table Selected)
**Additional Details****Previously Presented Material:** This material was presented at the LPSC 2013 conference
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